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Implementing 2nd Milk's Use of the World Health Organization Standardized Growth Charts to Better Track the Growth and Development of the Malnourished and Orphaned Infants in Their Supplemental Nutrition Program in Malawi

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**Internship: Implementing 2nd Milk's Use of the World Health Organization
Standardized Growth Charts to Better Track the Growth and Development of
the Malnourished and Orphaned Infants in Their Supplemental Nutrition
Program in Malawi**

Allie Wycoff

Eleanor Mann School of Nursing, University of Arkansas

NURS 498VH: Honors Internship/Service-Learning Thesis

November 14, 2021

2nd Milk Internship Experience Reflection

Introduction

Jason and Lacey Carney relocated to Malawi from Northwest Arkansas in 2013 to pursue a calling to work at the orphanage, Esther's Place. During their two year-long stay in Eastern Africa, the Carney's recognized just how many otherwise healthy babies were failing to thrive due to malnutrition and realized how beneficial a formula donation program could be in improving and sustaining their health. The couple was inspired to begin their nonprofit organization, 2nd Milk, to do just that. 2nd Milk continually raises money and collects resources in the United States for these children, and the Carney's oversee frequent visits to rural Malawi where formula and other resources are distributed to villages with high rates of malnourished orphans. The main villages assessed for the sake of my project are in the cities of Ntcheu, Lilongwe, and Nsungwe, although 2nd Milk impacts many other villages. The organization has a team of nutritionists that stay in-country to monitor the progress of the infants through their journey into toddlerhood. The nutritionists visit each of the villages that 2nd Milk has adopted once a month to monitor the overall wellbeing of the children and to gather basic measurement data to track nourishment status of the babies as they progress through the formula program. Staff also gathers social information about their babies on each visit, recruits other malnourished babies from the village, and helps arrange physician appointments in the city for sick infants. The program allows their infants to stay with their community and does not operate as a nursery or orphanage. Because of this, daily weights and percentiles cannot be tracked. Their current means of data collection includes basic measurements like height, weight, and mid-upper arm circumference (MUAC) once a month. MUAC provides a basic understanding of the infant's current malnourishment status and is currently the primary diagnostic tool used to determine

which infants are to receive formula, and how much each baby should receive. This data is critical but falls short on the analysis side. Height, weight, and head circumference should also be considered in the diagnosis of malnourishment and in the organizations assessment of the severity of under nutrition. Jason Carney voiced an interest in gaining a better metric for analyzing data and for tracking the progress of the infant's growth throughout 2nd Milk's formula feeding program, and a recent nursing school pediatric skills labs had prepared me perfectly to equip 2nd Milk with just the right tool: the World Health Organization (WHO) standardized growth charts. The pediatric skills lab I had just completed focused on infant measurement collections where I learned how to correctly gather data and how to use tools such as the WHO growth charts to assess and analyze the measurements. It was vital that 2nd Milk had a quick, accurate, and worthwhile tool to use during their short visits with numerous babies at one time. These charts combine the data that the staff was already collecting with the addition of one more measurement, head circumference. This extra bit of data allows 2nd Milk to place their babies along a growth chart curve and compare their development and nutrition status to the accepted world-wide "norm" of what a healthy child should look like. The WHO was able to define what adequate nutrition status looks like on a chart, giving 2nd Milk the ability to easily see where their babies fall into the nutritional spectrum. By taking just a few measurements they can accurately determine if the child is adequately nourished, under nourished (malnourished), or over nourished (obese). The nature of the charts allows for staff to keep one chart per infant and update their status each month when they reassess the child. The collection of plots on the individual child's chart over time will connect to show a curve, which can be analyzed to determine if the malnourished baby is making progress towards adequate nourishment after spending time in the formula program. The goal for my thesis project was to teach staff how to

utilize the WHO growth charts to help 2nd Milk redesign the ways that they assess their baby's nutritional status as well as helping them define admitting and discharging criteria. Once they gather data on a new infant and plot the information onto the growth chart, they can see if the baby measures as "malnourished", and then decide to admit the child into the program. After spending an extended time nourishing the baby, they can reassess his or her status over the following months and begin to discharge the child as they continue to express as "adequately nourished" on their growth chart. The following four charts were taught to staff and used to assess the infant's percentiles:

- Birth to 24 months: Boys Weight-for-length percentiles and Head circumference-for-age percentiles
- Birth to 24 months: Boys Length-for-age percentiles and Weight-for-age percentiles
- Birth to 24 months: Girls Weight-for-length percentiles and Head circumference-for-age percentiles
- Birth to 24 months: Girls Length-for-age percentiles and Weight-for-age percentiles

The question asked and experimented on is this: are the World Health Organization Standardized growth charts a successful tool for 2nd Milk to use in assessing the nutritional status of the malnourished orphaned infants in their formula donation program? Specifically, do these charts help the staff better understand and track the growth and development of the infants through their time in 2nd Milk's program? This service-learning project does not focus on *how* successful 2nd Milk's formula program is at nourishing babies, rather on the success of the growth charts as a tool for 2nd Milk to use to better understand their work and their baby's

nutritional status. Success of this project would mean that staff understood how to use the charts and the gravity of what chart utilization could mean for their tracking efforts, and that it was ultimately a tool that benefited the non-profit organization. Failure of this project would mean that the WHO growth charts did not prove to be a meaningful tool in assessing the nutritional status of babies and that it was otherwise inconvenient for staff to use and was not something they were able to adopt into their routine assessment.

Personal success of this project would mean that I was able to make a difference for an organization whose mission I firmly believe in, that I was able to gain a worldly understanding of what pediatric health looks like, and that I may foster my passion for caring for underserved patients who would benefit from my advocacy, compassion, and effort. My career aspiration is to work in the Neonatal Intensive Care Unit (NICU) and Pediatric Intensive Care Unit (PICU) to gain experience before working as a Certified Flight Registered Nurse (CFRN) specializing in Pediatric and Neonatal transport. This project will expand my understanding of working with children and will prove to be great experience as I progress further in my career.

Reflection

My honors college thesis project was completed alongside a recent 2nd Milk trip to Malawi from June 19, 2021, through July 3, 2021. Before the trip began, I worked closely with 2nd Milk staff to gain an understanding of how they currently operate and to teach them the basics of the WHO growth charts. I video chatted with staff members, met with the Carney's in person, and drafted ideas about efficient and meaningful ways to track and assess the nutrition status of the infants I would soon work with. Over the course of the thirteen-day trip I worked hands-on to help the non-profit update their infant tracking and measurement metrics by gathering measurements during field visits and later plotting the infants onto their individual

growth charts. My 120 hours were earned cumulatively before the trip and on the trip from June 19, 2021, to July 3, 2021. Overall, my main responsibility was assessing the importance and sustainability of the WHO growth chart use for 2nd Milk moving forward.

The WHO growth charts joined the collection of paperwork that typically accumulates on staff's clipboards for field visits. 2nd Milk relies primarily on paper health records to keep their data. When they go on a field visit, they bring along two sheets of paper: a "Baby Update Sheet" and a "Child Evaluation Form". Below, one of the baby's paperwork from one visit is attached, typed exactly as seen in the 2nd Milk paperwork. Head circumference and WHO growth chart, marked below with asterisks (*), represents additional information that I included to their usual assessment.

2nd Milk Baby Update

Baby's Name: Victor Tsanzo

Current Weight (Kgs): 7.6 Kgs

Previous Weight (Kgs): 7.3 Kgs

Height (cms): 64 cms

MUAC (cms): 13.3 cms

*Head Circumference (cms): 46 cms

Date of Birth: 29/01/2021

Age: 5 Months

Place of Birth: Ntcheu (Hospital)

Date of Visit: 25/06/2021

Date Entered 2nd Milk: 22/4/2021

Boy or Girl: Boy

Baby's Home Village: Daudi

Feeding Centre: Ntcheu

Is the Baby on Probation?: No

Is this a New Baby?: No

Formula Given: Lactogen #1

STATUS OF THE BABY

Mother Alive?: No

Is the Baby Smiling/Laughing? Baby Talk? (Cooing Noise): Not yet

Can they Hold Their Head up on Their Own?: Yes

Can They Roll Over? Sit up on their own? Crawl? Stand on their own yet?: yes

Any Teeth? If so, how many?: No

Sleep Through the Night?: yes

Can They Hold Their Bottle by Themselves?: yes

Condition of the Baby the Day of Visit: The condition of the baby is well and in good health

Condition of the Last Visit to Present (Has been sick?, went to the hospital? What was the problem? How is the baby now? How active was he on the day of visit?): Last visit he was suffering with cough for 3 days and he go to the hospital and received medicine but now he is healed.

LIVING CONDITION

Type of House They Live in: They live in grass thatched house and floored

Meals Per Day: 4 time a day

Whom Do They Live With Currently: Aunt

What Place They Sleep on: Sleep on bed

GUARDIAN CONDITION

What They Are Currently Doing to Support the Baby: the guardian she buy and sell tomato to support baby

Challenges Facing While Raising the Baby: the guardian she sell she can't manage to support the baby

Health Condition of The Guardian: She is well and in good health

Who They Live With? (How Many People): other 5 members

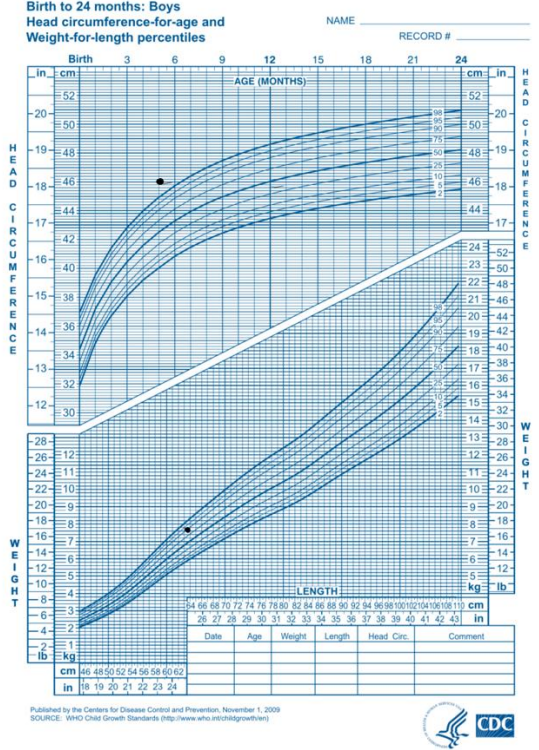
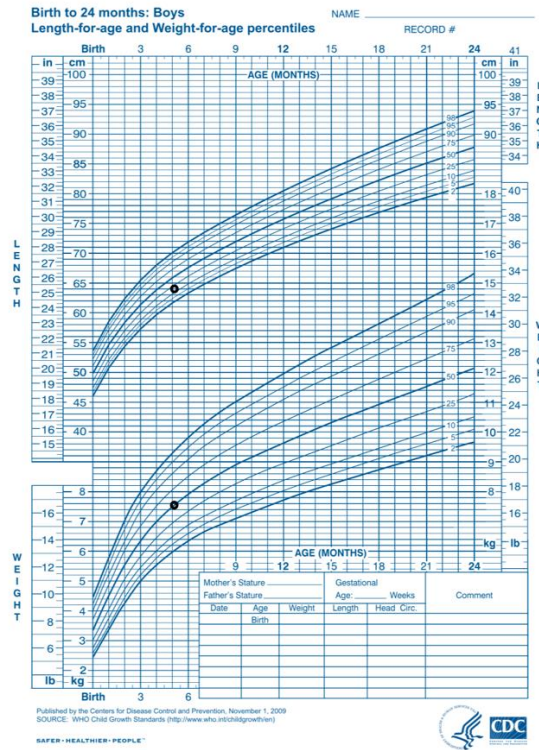
CHILD EVALUATION FORM

Baby's Name: Victor Tsanzo

Location/formula centre: Ntcheu

Date	Age	Weight	Height	MUAC	Remarks
22/4/21	2 ms 2 wks	5.5kg	x	x	
25/5/21	4 ms	7.3 kg	x	x	
25/6/21	5 ms	7.6 kgs	64 cms	13.3 cms	

WHO GROWTH CHARTS



After reviewing the paperwork completed on a field visit, many conclusions can be drawn. First, one may compile the data to gain an understanding of the baby. From baby Victor Tsanzo's information shown above, one can conclude that the baby appears to be adequately nourished. His height, weight, and head circumference fall onto a curve, and do not outlie critically. His head circumference does measure a bit high which may indicate some health concerns such as potential hydrocephalus, but this would need to be assessed again in following months to see if any real issues persist. This alone shows the importance of adding head circumference to their monthly assessment, as it has the potential to draw attention to certain neurologic disorders. His provided social history allows one to gain a holistic view at his health and a better understanding of his housing and familial situation. And the information provided about his motor skills and cognitive abilities such as holding a bottle, cooing, or sitting and standing are vital in understanding his development status. Additionally, though, conclusions

about 2nd Milk's data collection methods can be drawn. The "Child Evaluation Form" expresses gaps in data collection which exposes a massive flaw in 2nd Milk's efficiency. These basic measurements are critical to collect and record to allow for adequate growth tracking. Without consistent measurements, any data collection at all is much less meaningful. A true understanding of the impact that 2nd Milk's formula program has on these orphans is made when comparing an infant's admitting measurements to his current, and eventual discharge, measurements. When a staff member fails to record any of these anthropometric bits of data during a monthly visit, tracking can be skewed for the entirety of the infant's growth progression as babies change significantly from month to month. It is vital that all measurements are taken and recorded at least once a month per baby so that plotting on their growth charts may be consistent and meaningful.

Missing data is not the only flaw I observed in 2nd Milk's current field visit information collection. Other barriers and challenges exist in the ways they gather data, such as inconsistencies in weight and height. Weight inconsistencies exist because the nature of field visits does not allow for the babies to be stripped nude and weighed on a table scale. Instead, a hanging scale is secured to a tree branch or pavilion beam and each baby is tied to the hook with their personal blanket. These babies do not often wear diapers, so the blanket is usually soiled. Field visits are completed at the central feeding center which serve many villages. Sometimes villages are far from the feeding center so families must trek long distances to come get their formula donation. The long journey almost always ends with the baby having an accident in their blanket, which adds to their documented weight. Height discrepancies are due to the squirming nature of infants and the lack of extra staff to help hold the child while another staff collects the length. Field visits are very rushed and crowded. Many families fill a small common space and

want their baby to be assessed right away so that they can get their donation and head back towards home. The small number of staff paired with the high number of people at these visits keeps every staff member sufficiently busy for the entire time. Each staff member is assigned a job of either assessing babies or distributing donations, and additional staff assistance in completing a job is scarcely provided.

My response to the controlled chaos of field visits was to tap into my prioritization and delegation skills. These skills were acquired and practiced in various settings throughout nursing school, both in didactic and clinical lessons. The Eleanor Mann School of Nursing courses teach its students how to think like a nurse. To prioritize the most vital things first, the things that must happen to achieve the bottom line of functionality. The partnered clinical experiences in nursing school allow students the opportunity to practice the skills of prioritization and delegation by working in a hands-on, real-world situation. I have learned through these lessons that nurses work most effectively when they are analyzing the full picture and ensuring that each piece of the puzzle is in working order. I delegated easier tasks to volunteers with no medical background. Things like getting families into lines and passing out donations. I then worked with 2nd Milk staff to collect the measurements, making sure I gathered head circumference as it was a new measurement to the staff at the time. Through my collaboration with them I learned that, if work is to be done, it must be done completely and well. As mentioned above, gaps in data can void the meaningfulness of the remaining data. One cannot accurately assess an infant's nutrition status based on head circumference alone. All data must be gathered to use to growth charts in their entirety. Likewise, one cannot accurately assess the growth progress of a child if data is not collected correctly and consistently each month. Data must be collected accurately and in its full entirety to truly impact 2nd Milk's understanding of each baby's growth progress.

Despite the slight errors that inevitably made their way into data collection, the use of the WHO growth charts proved to be a meaningful tool in determining the nutritional status of the infants in 2nd Milk's formula donation program. Other tools may indicate nutritional status more definitely, such as drawing blood and examining lab work. A test like this would provide much more information about true nutritional status of the baby but is an unreasonable tool for the circumstances in Malawi. The cost of resources associated with getting blood chemistry values are unlikely to be sustainable for a non-profit organization to provide villages with in Eastern Africa. The growth charts, though, are cost effective, time efficient, and meaningful in data analysis. The charts provide staff with real insight on the babies overall growth development progress and only require a few measurements to be completed. For that reason, the sustainability and practicality of the WHO growth charts proved to be a success in helping 2nd milk gain a better metric in tracking and understanding their babies.

My presence on this year's trip to Malawi did not only benefit the non-profit's tracking metrics, but also benefitted me greatly. The opportunity to work so closely with vulnerable newborns is an experience that significantly impacted my future career. As an aspiring neonatal registered nurse and certified pediatric flight registered nurse, it is vital that I have a well-rounded understanding of the numerous diagnoses and disorders that plague newborns. During a field visit, one of the infants that I was holding began to have a seizure while I was attempting to measure head circumference. It was almost hard to tell exactly what was happening as his tremors were gentle, but his grandma shared with me that he has seizures multiple times a day. I was dumbfounded as I had very little understanding of the exact pathophysiology behind infantile seizures. I had wished that I had medical advice to provide his worried grandma with, but was only able to share my basic understanding of seizure protocol (make sure the scene is

safe, do not restrict tremors, and do not place anything in their mouth). The 2nd Milk staff and I were able to set up a physician visit for the infant and arrange for their transportation but I wished there was more I could have done to help this family. In my clinical rotations I had seen health care professionals make significant impacts on their patients by performing CPR, administering life-saving pharmaceuticals, and diagnosing critical conditions. In this moment, though, I felt that I was not able to make much of a difference at all outside of referring them to a Medical Doctor. My trip to Malawi with 2nd Milk was, more than anything, a reminder of how fragile life is and a reminder of how much impact nurses can have in dealing with the fragility of life. The people that I interacted with on-site gave me a new perspective on the things that are truly important in life. I was reminded through them of the bottom tier of Maslow's Hierarchy of Needs: food, water, and shelter. Before anything else can be worried about, the most basic, physiological needs must be met. These communities had shelter that they built from natural resources. They had water that they pulled directly from the ground thanks to another mission group who had provided them with water wells. Through natural resources, and the help of organizations like 2nd Milk, these people had food. They had all of the basics met to sustain life, and business seemed as simple as that. The people took care of one another, and I saw first-hand why Malawi is fondly known as "The warm heart of Africa". It was truly a life changing experience that helped me secure a solid foundation of my budding career as a patient advocate, as a compassionate caregiver, and as a nurse.

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Abstract

This article considers the history and implications of the World Health Organization (WHO) standardized growth charts as well as the significant impact that growth chart utilization may have on 2nd Milk's ability to understand and track the nutritional status of the malnourished orphaned infants in their formula program. Specifically, this literature review examines whether or not the WHO growth charts are a meaningful tool for 2nd Milk to adopt into their monthly baby assessments. The WHO growth charts are calibrated to express an accepted international "norm" for what an adequately nourished child looks like. In a recent service-learning initiative project, 2nd Milk piloted the use of these charts to assess their babies against the accepted worldwide healthy baby norm. The following literature is systemically analyzed to contemplate the potential use of other growth charts, but ultimately indicates that the WHO growth charts are in fact an effective metric for the tracking and assessment of nutrition status in these malnourished infants in the 2nd Milk formula program. Additional research provided emphasizes the importance of early detection and management of malnutrition.

Introduction

According to Kumbani's 2007 article "Maternal and Newborn Health in Malawi", Malawi has some of the poorest indicators of newborn and maternal health in developing countries. She states that 1,120 women die per 100,000 live births and recounts that this is one of the worst ratios in Africa. She also mentions that the fertility rate is high, averaging about 6.3 children per woman. High fertility rates paired with staggering maternal mortality rates equates to a high number of motherless children, which we will refer to as orphans despite the potential of these children having a living father. These orphans tend to live with close relatives or community members after the passing of their mother and typically receive suboptimal

nourishment. Despite the high level of care that the orphan's adoptive families may provide, these families usually are not able to provide one key factor that is a determinant of infant survivability- adequate nutrition. On September 19, 2020, the World Health Organization (WHO) published an article titled "Newborns: Improving Survival and Well-Being". In this article they outline five things essential to ideal newborn care: thermal protection, hygienic umbilical cord and skin care, exclusive breastfeeding, assessment for health problems, and preventative treatments. All of these factors are things that adoptive families may be able to provide an orphan with, except for exclusive breastfeeding. Even if an adoptive mother were able to breastfeed the adoptive child, breastfeeding non-biological children is culturally forbidden in Malawi due to high rates of HIV and AIDS and the likelihood of transmitting these diseases to the infant. This means that orphaned infants must rely on formula feeding for nourishment, but formula is hard to come by as it is sold for high prices at the market, which is usually located far away from the villages where these families reside. Distance from resources as well as scarce income creates a high likelihood of malnourishment for this specific demographic of babies. The International Monetary Fund reported in July of 2017 that 65% of Malawi households were food insecure and that 71% of the country fell below the poverty line of \$1.90 USD per person per day. Due to this economic climate and the high price of supplemental nutrition, providing adoptive children with adequate formula feeding is financially taxing and overall unlikely for the adoptive families. The non-profit organization, 2nd Milk, was founded to ameliorate this disparity. This organization seeks out villages in Malawi with high rates of malnourished orphans and donates supplemental nutrition directly to them. 2nd Milk also checks on the nutrition status of the infants in their program every month at their routine village visit. Prior to the recent service-learning initiative in June of 2021 that introduced the organization to WHO

growth charts, 2nd Milk relied on basic anthropometric measurements to understand the health status of their babies. Data like height, weight, and mid-upper arm circumference (MUAC) were the only measurements taken and analyzed. The non-profit admitted to needing an improved tracking metric to assess the progress of their infants through the formula program so the WHO growth charts were tried and tested for effectiveness. But, before the growth charts can be fairly assessed as an effective tool for 2nd Milk, the history and context of the charts must be understood.

The WHO growth charts were calibrated to establish a foundation of our global understanding of what “healthy” children look like when raised in environments that do not constrain growth. The World Health Organization ran a study between 1997 and 2003 called the WHO Multicentre Growth Reference Study that compared the growth and development of children from six different countries (Brazil, Ghana, India, Norway, Oman, USA). The children examined were provided an optimal start in life to ensure they had the means to grow to the ideal range of height and weight for age regardless of geographical location. To achieve these conditions the study focused on the breastfed child as the biological standard or “norm”. The WHO states that “the nutritional, immunological and growth benefits of breastfeeding have been proven, and so the breastfed infant is the natural standard for physiological growth. The adequacy of human milk to support not only healthy growth but cognitive development and long-term health provided a clear rationale for basing the WHO growth standards on breastfed infants” (WHO.int, April 4, 2011). The children assessed for this study aided in the development of a global standard for childhood growth progression. This global standard is a series of charts that depict what exactly “normal” growth progression is expected to look like across socioeconomic and ethnic realms. The charts are used to assess whether children are growing to

ideal ranges (adequately nourished), not growing to full capacity (undernourished/malnourished), or are growing over expected ranges (over nourished/overweight). Further implications of this tool include assessing the wellbeing of children, including measuring the success of efforts to reduce child mortality, malnutrition, or disease. As of early 2011 over 140 countries had adopted these charts as a means to measure childhood growth and development.

The WHO growth charts have great potential in helping this non-profit analyze the health of the infants they serve. 2nd Milk's previous assessment relied mainly on mid-upper arm circumference to diagnose the severity of the infant's malnutrition, but other measurements like height, weight, and head circumference are also critical and must be considered. Decisions about which infants were to receive formula donations and how much formula each specific baby should get were previously based on their arm circumference and perceived malnourishment level. This process could be bettered by implementation of the growth charts and the primary goal of this literature review is to better understand whether or not it would truly benefit 2nd milk to utilize the World Health Organization standardized growth charts as a growth tracking, data analysis, and diagnostic metric.

Methods

The database MedLine was accessed to identify relevant articles for this literature review. The phrases (malnutrition OR undernourishment OR undernutrition) AND (growth charts) were searched with additional search criteria including a) publication date of January 2011-December 2021, b) full text available, and c) age: infant 1 month-23 months. Medline populated 30 journals which were sorted through additional inclusion and exclusion criteria to cultivate 15 relevant academic journals. The inclusion criteria required the article to be a) a primary, peer reviewed

source and b) relevant to 2nd Milk's use of WHO growth charts. Exclusion criteria included a) the article was not relevant to the nursing scope of practice.

Results

Infants and young children are in a nutritionally vulnerable stage of life, especially those in Sub-Saharan Africa and South Asia where malnutrition rates are highest. Malnutrition is a major predisposing factor for eventual morbidity and mortality. Adequate nutrition, though, prevents failure to reach biological growth potential (growth defined as the well-being and development of the individual). Around the world, 30% of children under 5 years of age present as underweight and with stunting (Rooze et al., 2012). "Inadequate caloric intake is the most common cause of [malnutrition and stunting]. Difficulty attaining or maintaining adequate weight can impede appropriate height, head circumference, and development of cognitive skills or immune function in extreme cases. Early identification and management of...undernutrition [is] critical." (Homan et al., 2016). Identification of malnourishment can be achieved by assessing anthropometric measurements of infants and children along an accepted growth standard, whether it be the growth charts of the World Health Organization, Center for Disease Control and Prevention, National Center for Health Statistics, or even regionally and locally accepted growth charts.

In Ethiopia, malnutrition is routinely assessed by measuring mid-upper arm circumference as seen in the article "Routinely MUAC screening for severe acute malnutrition should consider the gender and age group bias in the Ethiopian non-emergency context" (2020) by Masresha Tessema et al.. The article mentions that early identification of severe acute malnutrition (SAM) in children under 5 is a high priority to reduce mortality and improve health outcomes, and that current practices within the country include identifying children with SAM if

their MUAC measures less than 115 mm. The authors argue that the measurement of MUAC alone does not accurately assess nutrition status as it does not account for weight-for-height scores. The authors share that there has been an alarmingly low rate of SAM diagnosis due to this 115 mm cut off, with only 55% of malnourished children being accurately identified. It is unethical and irresponsible to use only MUAC < 115 mm to diagnose SAM in this population as many children will be left undiagnosed and untreated. A conclusion drawn to ameliorate this unethical dilemma is to have a two-step identification process. The first step is to change the MUAC cutoff to < 125 mm instead, and to have this screening completed at a community level to ensure inclusion of as many children with SAM as possible. This cutoff change alone could identify over 60% of the affected children. The second step is to ensure that all children with a low MUAC are assessed at a health facility for weight, height, and MUAC measurements to then be assessed on the WHO growth charts. This would allow for nearly all cases of SAM to be diagnosed so that treatment could be initiated. Lastly, if SAM is not confirmed but malnourishment is still suspected, preventative counseling should be initiated to avoid future malnutrition problems.

Meanwhile, in Indonesia, the main growth chart utilized for pediatric and neonatal nutrition assessment is the Indonesian National Growth Reference as seen in Novina Novina et al.'s journal "Indonesian National Growth Reference Charts Better Reflect Height and Weight of Children in West Java, Indonesia than WHO Child Growth Standards". This article remarks that the World Health Organization child growth standards "seriously overestimate the true prevalence of undernutrition" in Indonesia, and that "Indonesian National Growth Reference charts appear superior for practical and clinical purposes, such as detecting growth and developmental disorders". The Indonesian Basic Health Research 2018 indicated that Indonesian

children are just genetically short but that these same children were diagnosed as stunted according to the WHO charts. In fact, the WHO charts say that over 50% of the children in Bandung are stunted. Since Bandung children are shorter and slimmer by nature, they appeared to be measuring as stunted and wasted when they are not truly suffering from malnutrition. According to the journal, "short stature is not a mark of under nutrition". The WHO charts give an impression that these children suffer from malnutrition but this impression is deceptive. Bandung district is wealthy with marked evidence of food security and no signs of food shortage or clinical signs of malnutrition. For this community, use of the WHO growth charts proves to be inappropriate and harmful. Instead, locally accepted growth charts are a much more meaningful tool.

Comparatively, In Egypt, the WHO growth charts are utilized in tandem with a local growth tracker, "STRONGkids score", to assess malnourishment data. The academic article "Nutritional risk screening of hospitalized children" by Sanna Shaaban et al. is a cross sectional study that assesses the risk for nutritional derangement in hospitalized children under three years old. This study uses the WHO growth charts to define underweight, wasted, and stunted. The nutritional risk screening was conducted on 500 children admitted to a children's hospital in Cairo, Egypt, where each child was assigned a STRONGkids score. This score is an "easy to apply nutritional risk screening tool" that considers subjective clinical assessment, high-risk disease, nutritional intake, and weight loss or poor weight gain. The study revealed sufficient results about malnourishment levels throughout hospital stays for various children and marked the STRONGkids scoring tool as an effective way to gauge nutrition status. This regionally accepted tool was built off of the internationally accepted WHO growth chart values, marking the WHO charts as a beneficial tool in the global understanding of children's growth and

development. Cairo, Egypt successfully implemented both the use of a local growth tracker and the WHO growth charts, additionally emphasizing the importance of looking at nutrition status holistically.

Czech Republic, on the other hand, piloted the use of the WHO growth charts alongside their usual utilization of the Czech Growth References to examine which chart might be more meaningful in nutrition status assessment. Jana Vignerova et al. wrote an article titled “The Prevalence of Wasting in Czech Infants: A Comparison of the WHO Child Growth Standards and the Czech Growth References” examining the differences between the 1991 Czech Growth References and the 2006 WHO growth charts. After comparing and contrasting the use of the two assessments, the study revealed that prevalence of wasting was significantly higher among the WHO charts than the local Czech References. This proved that the WHO growth charts may have potential in identifying malnutrition better than their local growth chart or running the risk of inappropriately over diagnosing malnutrition like in Bandung. Ultimately, though, it was concluded that the WHO growth standards should be evaluated further before official adoption into the Czech Republic, as they currently have no issues relying on their own local growth references.

Xinnan Zong et al. of China wrote an article in 2017 assessing various charts for their significance in assessing nutritional status of infants through post-pubertal adolescents. The article recounted that “the report for worldwide implementation of the WHO child growth standards showed over 70% of the surveyed countries adopted weight-for-length/height and the figure was only 29% for BMI-for-age. So, at present, a set of reliable weight-for-length/height curves is still very useful for the assessment of physical proportion and the surveillance of malnutrition in pediatric outpatients and public health. Although weight-for-height growth

curves for adolescent children have not been constructed or released by many countries or organizations in recent years, some countries still insists on establishing their own weight-for-height references..." (Xinnan Zong et al.,2017). Ultimately, Zong et al.'s conclusion was that this specific demographic of patient might benefit from use of the weight-for-length/height charts more than the BMI-for-age chart. This journal challenges the status quo of assessing nutritional status and makes sure to use evidence based practice. Zong's article considers how other countries track growth and development but ensures that China uses what is best for their individualized needs based on research and experimentation.

In Nigeria, there is little debate about which growth chart to use, because the current conversation focuses on whether or not staff is prepared to accurately use any type of growth chart. The article "Health staff understanding, application, and interpretation of growth charts in Nigeria" by Ezeofor et al., 2016, concludes that growth charts might be meaningful, but that staff errors cloud their ability to truly draw conclusions. The article says that "implementation of the WHO 2006 growth charts might enhance recognition of slow weight gain patterns. However, the interpretation of weights plotted over time is still very poor, and more research is needed to develop effective training strategies, if charts are to be used effectively, for example, preservice training on plotting and interpreting growth measures, with supportive supervision to reinforce effective use of acquired skills." The article summarizes the need for policies to be made towards periodic quality training for health staff on growth monitoring metrics. Accurate plotting was a challenge for staff in multiple African countries, ultimately reflecting a need for better training before effectiveness of specific growth charts can be analyzed.

In India, debate exists about the need for a new growth chart altogether. Pritam Roy et al.'s 2014 article "Designing New Growth Chartsfor Low-birth Weight Babies: Need of the Hour

in India” questions if the WHO growth charts are applicable for the growth of low-birth-weight (LBW) babies as the WHO chart's do not consider birth weight as an indicator. The article explains the specific ways that LBW babies have a distinctly different pattern of growth compared to normal babies and contemplates the increased risk of exposing these LBW babies to adult diseases later in life by assessing them on the well-baby growth charts as infants.

Ultimately, this article concludes that the WHO growth charts represent the highest quality knowledge available today about how children should grow and develop, but the article says that we ought to consider the possibility of creating a specialized chart for the vulnerable population of LBW babies in the future.

This same demographic of LBW neonates were assessed against the use of WHO growth chart's again in another article by Kanya Mukhopandhyay et al. The article “Longitudinal Growth and Post-discharge Mortality and Morbidity Among Extremely Low Birth Weight Neonates” (2014) studied weight, length, and head circumference of extremely low birth weight neonates at corrected ages 3 months, 6 months, 9 months, 12 months, and 24 months compared to WHO growth charts. The study found that the neonates significantly improved from 3 to 24 months, but that many of these babies still remained malnourished at 24 months and remained significantly growth retarded despite that they improved their growth a sizeable portion. The article could be used to support Roy's vision of specialized growth charts for LBW neonates, but ultimately concludes that the most vital concern is early assessment and management of malnutrition as well as consistent tracking throughout treatment. The article states that “it is important not only to emphasize on their immediate postnatal nutrition but also continued monitoring of their diet and growth during follow-up, appropriate timely intervention and adequate pre-discharge counseling to prevent mortality and morbidities”.

Bagri et al.'s article "Impact of Malnutrition on the Outcome of Critically Ill Children" drew a similar conclusion on the importance of growth chart use in the early diagnosis and treatment of malnutrition. This article determined that pediatric ICU outcomes were influenced greatly by the nutritional status of the child after stabilization and that children who were severely malnourished had significantly prolonged ICU stays. This study observed 332 critically ill patients aged 1 month-15 years old whose anthropometric parameters were recorded to assess their nutritional status against the WHO growth charts. The charts served as a tool to diagnose exact nutrition status so that the patient could receive appropriate nutrition supplementation depending on severity of under nutrition. This study highlighted the ultimate need for appropriate nutritional assessment in sick children and emphasized the need for nutrition protocols in the PICU to prevent morbidities and mortalities. The WHO growth charts proved to be a meaningful tool in the assessment and treatment of these patients.

Of the many types of growth charts discussed, WHO growth charts and locally accepted growth charts are not the only options for health professionals to consider in their assessment of nutritional status. C.R.M. Silveria et al. published a journal in 2011 comparing the top three growth charts available to health professionals: National Center for Health Statistics (NCHS/1977), Centers for Disease Control and Prevention (CDC/2000), and World Health Organization (WHO/2006). The article shares a brief history of the origins of the three different charts, beginning with the NCHS charts that included all age groups and social classes between the ages of 2 and 18, but only considered white, middle-class individuals for ages 0 months to 36 months. The CDC chart focused on American individuals of ethnic diversity between 0 to 20 years old. Lastly, the WHO charts, as mentioned above in the introduction, studied 0 to 5 year-old's from various ethnic groups (countries) based on what is considered "ideal" growth without

limitations to their development. Silveria et al.'s article compared use of the three charts regarding nutritional classifications of 377 children from 0 to 5 years old in a general hospital of high complexity in Southern Brazil. The article goes on to discuss very specific results for all three charts with each of the children but draws a final conclusion stating that "despite the strong agreement of the 3 charts, the adoption of the WHO charts seems to be more helpful for the children's nutritional screening for hospital admission, as it enables to detect a higher number of malnourished children at nutritional risk, who will benefit from an early intervention". The WHO growth charts proved to be the most meaningful tool for this study of hospitalized Brazilian children ages 0-5 compared to the NCHS and CDC growth charts.

Discussion

After further review of related literature, it is concluded that the WHO standardized growth charts prove to be a meaningful tool for data analysis and malnutrition diagnosis for 2nd Milk, as the charts will help the non-profit provide uniformity in the way that children in the program are assessed and how nutrition levels are monitored. Using this global standard provides the non-profit with a frame of reference for measuring deviations from the accepted international "normal, healthy child" in a time efficient and cost-effective way. Although it is difficult to establish a true "one size fits all" chart, this global standard helps to advocate for the malnourished infants by assessing where exactly their nutritional status is at. Knowing where the infants lie on the growth charts aids in early detection of nutrition related issues and is ultimately vital in the treatment of malnourishment.

As reviewed above, many countries have sampled the use of WHO growth charts as well as locally accepted growth charts. Results of the various studies were scattered. China focused their use on one specific WHO growth chart while some countries, like Egypt, built off of the

WHO growth chart values to create their own specialized way to track malnourishment status. Some countries, like Indonesia, were negatively impacted from the use of WHO growth charts because their specific children have a slimmer stature. The WHO charts diagnosed many of their children as malnourished when they were not truly struggling with such issues. For West Java, Indonesia, Indonesian National Growth Reference charts proved to be better catered to nutritional assessment. The Czech Republic piloted use of the WHO charts and considered the results of their experiment to potentially mirror those of Indonesia but concluded that more consideration must be done to truly determine. In India, specific concerns about the WHO growth charts were contemplated regarding low-birth-weight-neonates. Patterns of growth for LBW babies were studied and WHO growth charts lacking indicators for birth weight were considered. Further research noted that LBW babies measured as malnourished at 24 months corrective age and remained significantly growth retarded despite that they improved their growth. Despite hesitation, though, WHO growth charts were ultimately noted to be the highest quality knowledge available today about how children should grow and develop even for LBW babies.

Beyond controversies about which growth chart provides the most accurate understanding of nutrition status, all literature pointed to an agreement: early detection of malnutrition is a priority in preventing further morbidities and mortalities. From there, it is unanimously agreed that growth chart use must be consistent and correct. In Nigeria, WHO growth chart use cannot yet be assessed for effectiveness because staff is not trained sufficiently enough in correct use of the charts. The interpretation of their data is skewed and is altogether inaccurate because of poor preservice training. This shines light on an even larger conclusion drawn from all of the literature, regardless of geographical location and which specific growth

chart is used. That is, the creation of policies to a) ensure that staff is trained on accurate growth chart use, b) screening is implemented to identify malnutrition, and c) treatment is outlined to treat identified undernutrition. This idea is supported by Ethiopia's policy to provide preventative counseling to avoid future malnutrition problems in children who have suspected but undiagnosable malnutrition, and by the proposed policies put in place to in the Pediatric ICU to prevent malnutrition related morbidities.

After reviewing the related literature, 2nd Milk's implementation of the use of WHO growth charts is ultimately supported due to the uniform nature of the charts. It is understood that no chart can be a true "one size fits all", but that the WHO charts were created by a study that was broad enough to be appropriately used in the context of 2nd Milk's patient demographic. More important than picking the "right" chart for 2nd Milk to use, emphasis is placed on the idea that they must use some type of consistent growth chart. And, as mentioned in the Silveira's study, "the adoption of the WHO charts seems to be more helpful for the children's nutritional screening for hospital admission [than other growth charts], as it enables to detect a higher number of malnourished children at nutritional risk, who will benefit from an early intervention". Use of these WHO growth charts will provide valuable insight into the nutrition status of the infants that they serve and will aid in the timely diagnosis and treatment of malnourishment in the orphaned infants in Malawi.

Time Log

Date	Hours Spent	Description of Activity
04/27/2021	3	Initial Meeting with Jason Carney
05/01/2021	2	Video chat with 2 nd milk staff to discuss their current evaluation methods.
05/02/2021	1	Drafting a new evaluation questionnaire.
05/10/2021	1	Video chatting with 2 nd milk staff to discuss proposed new questionnaire.

05/19/2021	4	Meeting with Jason carney to discuss logistics of trip, limitations on site, and ideas for project.
06/14/2021	3	Collecting resources for project at local stores and from local health clinics.
06/19/2021	6	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/20/2021	9	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/21/2021	10	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/22/2021	12	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/23/2021	8	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/24/2021	10	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/25/2021	11	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.

06/26/2021	8	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/27/2021	10	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/28/2021	9	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/29/2021	6	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
06/30/2021	8	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
07/01/2021	3	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
07/02/2021	1	Field Visit: collecting donations from 2 nd Milk's head quarter office, travelling to a grocery store to purchase formula, travelling to a feeding center, gathering measurements of baby's, distributing donations, travelling back to 2 nd Milk head quarters.
Total:	125	

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